# *On the Refraction and Dispersion of Neon.*

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By the kindness of Sir William Ramsay and Mr. H. E. Watson we have had an opportunity of measuring the refractive index of neon with a large quantity of the gas (300 c.c.) which had been carefully purified by Mr. Watson. Subject to small corrections which he has not yet completed, the weight of 1 litre of the gas was 0·9005 gramme at 0° C. and 760 mm. pressure in London.

From 11 experiments which hardly varied by 1 part in 500 we find the refractive index at 0° C. and 760 mm. for the green mercury line ($\lambda = 5461$) to be 1·00006716 or, doubling for comparison with diatomic gases, 1·0001343.

For the dispersion the rays used were the mercury green and the cadmium red ($\lambda = 6438$),* and blue ($\lambda = 4800$). The following values were found for these wave lengths, as the mean of nine experiments :—

| $\lambda \times 10^8$. | $(\mu - 1)\, 10^6$. |
|---|---|
| 6438 | 134·02 |
| 5461 | 134·30 |
| 4800 | 134·63 |

Below are given the values of $b$ in Cauchy's formula, calculated from these figures, for each section of the spectrum.

Dispersion of Neon.

Values of $b \times 10^{11}$ in Cauchy's formula, $\mu - 1 = a\left(1 + \frac{b}{\lambda^2}\right)$.

| $\lambda \times 10^8$. | 6438—5461 | 5461—4800. | 6438—4800. |
|---|---|---|---|
| $b \times 10^{11}$ | 2·30 | 2·46 | 2·38 |

* We are indebted to Dr. T. M. Lowry for the very effective source of light used: an arc with poles formed of an alloy of silver and cadmium. See a paper recently read by him before the Physical Society.

Using the last figure, the refractivity may be expressed in Cauchy's formula,

$$\mu - 1 = 0{\cdot}0001332\left(1 + \frac{2{\cdot}38}{\lambda^2}\right);$$

but employing a formula of the Sellmeier type,

$$\mu - 1 = \frac{5{\cdot}133 \times 10^{27}}{38517 \times 10^{27} - n^2},$$

where $n$ is the frequency of the light vibration and equals $V/\lambda$.

Previous measurements having shown that the refractivities of the inert gases are very nearly in the ratio of whole numbers, it was thought by us that the refractivity of neon would turn out to be exactly double that of helium: *i.e.*, 0·0001388. A value which is lower by 4 per cent. is unexpected. The explanation which at first suggests itself is that the gas might contain helium; but this is negatived by the fact that 8 per cent. of helium would be required, while Watson finds a higher density than Ramsay and Travers obtained for a specimen of gas whose refractivity was 0·0001374 for white light.

The coefficient of dispersive power in Cauchy's formula is actually lower than that found by one of us for helium (2·53), and only slightly higher than that found by Burton (2·2). In both cases, however, our figures must be received with caution. With our apparatus we were unable to count more than 200 green bands for neon, and 100 for helium, and the dispersive powers are so small that the figures cannot be trusted to less than 5 per cent. for neon, and probably 10 to 15 per cent. for helium. We hope to make a further attempt on these two gases later in the year with apparatus specially designed for the purpose.

We recently published values for the dispersion of helium, krypton, and xenon.* In these three cases the dispersive power was compared with that of air, for which Scheel's value ($b = 5{\cdot}67 \times 10^{-11}$) was assumed. Having now measured the dispersion of air ourselves, and found it slightly higher ($b = 5{\cdot}8 \times 10^{-11}$) in the visible spectrum, we annex our revised values, presented in the form of equation of Sellmeier type, and also the figures of Burton for helium and argon reduced to the same form—

* C. and M. Cuthbertson, 'Roy. Soc. Proc., vol. 81, p. 440, 1908.

Refractive Indices of the Inert Gases.

| Element. | $\mu - 1$. | Observer. |
|---|---|---|
| Helium ......... | $\dfrac{2 \cdot 84 \times 10^{27}}{40900 \times 10^{27} - n^2}$ | Burton. |
| Helium ......... | $\dfrac{2 \cdot 46 \times 10^{27}}{35500 \times 10^{27} - n^2}$ | C. Cuthbertson and E. P. Metcalfe. |
| Neon ............ | $\dfrac{5 \cdot 133 \times 10^{27}}{38517 \times 10^{27} - n^2}$ | C. and M. Cuthbertson. |
| Argon ............ | $\dfrac{9 \cdot 124 \times 10^{27}}{16335 \times 10^{27} - n^2}$ | Burton. |
| Krypton ......... | $\dfrac{10 \cdot 945 \times 10^{27}}{13039 \times 10^{27} - n^2}$ | C. and M. Cuthbertson. |
| Xenon ............ | $\dfrac{12 \cdot 47 \times 10^{27}}{9140 \times 10^{27} - n^2}$ | " " |

# *On the Refraction and Dispersion of Air, Oxygen, Nitrogen, and Hydrogen, and their Relations.*

By Clive Cuthbertson, Fellow of University College, London, and Maude Cuthbertson.

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Though there have been many determinations of the dispersion of air, and a few of those of oxygen, nitrogen, and hydrogen, the degree of accuracy hitherto attained can hardly be called satisfactory. The figures given by careful observers are not concordant, and those who wish to make use of them in further research find little to guide them in choosing the best values.

This is our apology for undertaking new determinations, and for offering a brief summary and criticism of previous work.

The apparatus (Jamin's refractometer) and method were those previously described,* but two improvements were introduced. In measuring the dispersion of the inert gases we had balanced the retardation of light of

* C. Cuthbertson and E. P. Metcalfe, 'Roy. Soc. Proc.,' A, vol. 80, p. 411, 1908.